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BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

5 The present invention relates to an auto-reset leakage current circuit breaker having function of an over current limiter cutting off a power supply in the case of over current flows, having function of a leakage current circuit breaker cutting off an electric path automatically in the incidence of ground faults or leakage currents, and resetting both these functions after the elimination of the above causes.

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DESCRIPTION OF THE RELATED ART

15 Generally, in electric power distribution lines of low voltage, an overcurrent limiter and a leakage current circuit breaker are installed separately and independently. When an overcurrent flows in an electric path beyond a standard set-point value, the overcurrent limiter is operated to cut off the power supply to protect electrical machinery and apparatus. Furthermore, when an abnormal current flow is generated by a lightning flash to earth, surge or power leakage, the leakage current circuit breaker is operated to cut off the electric path.

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However, the abnormal current detector of the present leakage current circuit breaker is generally a zero (phase) sequence current transformer. Generally, a wave shape of a power supply is normal. However, causes such as a

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lightning flash to earth, surge or power leakage, makes the wave shape of the power supply abnormal. When the wave shape of the power supply is normal, the zero sequence current transformer does not generate a secondary output.

However, when the wave shape is abnormal, the zero sequence current

5 transformer generates the secondary output. The problem is that the present leakage current circuit breaker is operated in the case of not only power leakage but also lightning flash to earth or surge.

10 Additionally, after the cause that has operated the leakage current circuit breaker is eliminated, function of the leakage current circuit breaker is not reset to supply the electric power again. Therefore, someone goes to the place where the leakage current circuit breaker is and has to reset function of the leakage current circuit breaker manually.

15 As a result, it often requires too much effort and time to reset function of the leakage current circuit breaker, when leakage current circuit breakers are installed in mobile telecommunication repeaters or unmanned electric equipment placed in rooftop of buildings or up-country, or street lamps placed in far distance among them.

SUMMARY OF THE INVENTION

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The purpose of the present invention is to provide an auto-reset leakage current circuit breaker performing functions of cutting off overcurrent flows and leakage current flows, and having a compact size installed easily in a narrow

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space.

The other purpose of the present invention is to provide an auto-reset leakage current circuit breaker resetting it's function again after eliminating the causes, such as a lightning flash to earth, surge or power leakage, that have
5 generated abnormal current flows to operate the leakage current circuit breaker.

To overcome the above described problems, preferred embodiments of the present invention provide an auto-reset leakage current circuit breaker performing an overcurrent cut-off function, a leakage current cut-off function, and a reset function, and comprising: a zero sequence current transformer detecting abnormal
10 current flows generated by ground faults or leakage currents; an abnormal current detector comparing a value of the abnormal current flows, detected by the zero sequence current transformer, with a standard set-point value; a cut-off/reset controller operating a relay in the case of ground faults or leakage currents, or
15 resetting the relay in the case of elimination of the causes of the leakage currents; the relay cutting off or resetting an electric path by the order of the cut-off/reset controller; a minute current generator supplying minute currents to check leakage states, until the causes of the leakage current is eliminated, after the relay cuts off the electric path; and an auto-reset unit supplying a pulse periodically to check an
20 input signal after the cut-off/reset controller is operated to cut off the abnormal current flows.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which like reference numerals denote like parts, and in which:

Fig. 1 is a block diagram of an auto-reset leakage current circuit breaker according to the present invention;

Fig. 2 is a circuit schematic of the auto-reset leakage current circuit breaker of Fig. 1; and

Fig. 3 is a front view of the auto-reset leakage current circuit breaker of Fig. 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference will now be made in detail to preferred embodiments of the present invention, example of which is illustrated in the accompanying drawings.

Fig. 1 is a block diagram of an auto-reset leakage current circuit breaker according to the present invention, Fig. 2 is a circuit schematic of the auto-reset leakage current circuit breaker of Fig. 1, and Fig. 3 is a front view of the auto-reset leakage current circuit breaker of Fig. 1.

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The auto-reset leakage current circuit breaker of the present invention has a compact size with 7 cm in length, 16 cm in width, and 7 cm in thickness approximately shown in Fig. 3, and wires varistors to comprise a surge bypass device 110 for bypassing a surge, caused by a lightning flash to earth, e.g., to the ground, and an overcurrent limiter 100 cutting off overcurrent flows to protect electrical machinery, apparatus or lines.

The auto-reset leakage current circuit breaker comprises a zero sequence current transformer 220, an abnormal current detector 230, a cut-off/reset controller 240, a relay 250, a minute current generator 260, and an auto-reset unit 270. The zero sequence current transformer 220 detects abnormal current flows caused by ground fault or leakage current flows of electrical machinery or apparatus. The abnormal current detector 230 checks whether the value of the abnormal current flows detected by the zero sequence current transformer 220 is beyond the standard set-point value or not, or checks whether the value of the current flows after eliminating the cause of leakage current flows is below the standard set-point value or not.

Additionally, the cut-off/reset controller 240 operates the relay 250 when a lightning flash, surge, or power leakage occurs, or orders a control signal to the relay 250 to reset functions of the relay 250 after eliminating the cause of power leakage. The relay 250 performs function of cutting off or resetting the power supply according to the control signal from the cut-off/reset controller 240. Until eliminating the cause of the interruption after the electric current flow is cut off by the relay 250, the minute current generator 260 supplies a minute electric

current, i.e. test current, to recognize leakage states. After the leakage current flows are cut off by occurrence of the abnormal current flows, the auto-reset unit 270 supplies pulses periodically to make the abnormal current detector 230 compare an input signal with the standard set-point value sequentially.

5 Preferable operation procedures of the present invention are described in the following statements,

 As described in the above statements, it is known publicly that an overcurrent limiter cuts off the power supply to protect electrical machinery or apparatus when overcurrent flows are generated. Therefore, the overcurrent
10 limiter will not be described in detail in this discloser. On the contrary, this disclosure will describe function and operation procedures of the auto-reset leakage current circuit breaker cutting off or resetting the power supply automatically, when the leakage causes, such as a lightning flash to earth, ground faults, or leakage currents, are generated or eliminated.

15 Fig. 2 illustrates operation procedures of the leakage current circuit breaker connected electrically with the over current limiter. The zero sequence current transformer 220 detects abnormal currents flows generated by the leakage causes, such as a lightning flash to earth, ground faults or leakage currents.

 When a value of the abnormal current flows, detected by the zero
20 sequence current transformer 220, is lower than the standard set-point value of the abnormal current detector 230 comprising an integrated circuit (IC) U1, a transistor Q1 and condensers C1 to C3 and C12, the leakage current circuit breaker is not operated. However, when the value of the abnormal current flows is

higher than the standard set-point value, it will be recognized by the cut-off/reset controller 240, comprising an integrated circuit (IC) U2, transistors Q2 and Q3, diodes D1 and D2, resistances R9 to R12, a condenser C6, and relays K1 and K2, connected electrically with the abnormal current detector 230. Sequentially, the cut-off/reset controller 240 operates a cut-off signal input circuit 221.

Therefore, in the cut-off signal input circuit 221, a relay switch K2-NO connected with the resistance R1 is turned on. Simultaneously, a reset signal input circuit 222 is turned off, and the relay 250 is operated to cut off the electric path. When the electric path is cut off, a light emitting diode LED1 connected to the cut-off/reset controller 240 is turned on, and a light emitting diode LED2 connected to the load end is turned off. Therefore, diodes LED1 and LED2 show that the electric path is cut off and the electric power is not supplied. Accordingly, these diodes make an operator recognize easily whether electric currents flow or not.

When the relay 250 is operated, the minute current generator 260, connected with the relay 250 in parallel and comprising a condenser C10 and a resistance R13, supplies minute currents to the load end continuously to detect the leakage status of the electric path.

On the contrary, when the leakage causes, such as ground faults, are eliminated, the auto-reset unit 270 comprising an integrated circuit (IC) U2, resistances R5 and R6, and a condenser C4 generates a launch signal. Sequentially, when the value of the abnormal current detected by the zero sequence current transformer 220 is lower than the standard set-point value in the

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abnormal current detector 230, the cut-off/reset controller 240 connected with the abnormal current detector 230 resets the function of the relay 250 to the original states.

Therefore, the relay switch K2-NO of the cut-off signal input circuit 221 is turned off, the relay switch K2-NC of the reset signal input circuit 222 is turned on, and the relay 250 is reset. Furthermore, the diode LED1 connected with the cut-off/reset controller 240 is turned off, and the diode LED2 connected with the load end is turned on. As a result, the diodes LED 1 and LED2 show that the electric path have been reset automatically.

As described in the above statements, while the overcurrent limiter protecting electrical machinery and apparatus from overcurrent flows is reset manually like the way of the conventional method, the leakage current circuit breaker of the present invention cuts off the electric path in the case of abnormal current flows, such as ground faults or leakage currents, and is reset automatically by withdrawal of causes of abnormal current flows.

Therefore, to reset the function of the leakage current circuit breaker, the operator of an electrical machinery and apparatus rarely goes to the place where the leakage current circuit breaker is installed. In more, the auto-reset leakage current circuit breaker of the present invention has the over current limiter and the leakage current circuit breaker together in a compact size so that it is easy to be installed even in a narrow space. As a result, it is effective for an operator to manage such electrical machinery and apparatus with the auto-reset leakage current circuit breaker of the present invention.

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While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.